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SOVIET MACHINE BUILDING

No. 28

SELECTED TRANSLATIONS

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Introduction

This is a serial publication containing selected translations of articles on the machine building industry in the Soviet Union. This report consists of translations on subjects listed in the table of contents below.

a. Ways of Developing Automation and Mechanization at Enterprises of the Moscow City Sovnarkhoz

/Following is the translation of an article by A. A. Vikhirev entitled "Puti Razvitiya Avtomatizat- sii i Mekhanizatsii na Predpriyatiyakh Moskovskogo Gorodnogo Sovnarkhoza" (English version above) in Mekhanizatsiya i Avtomatizatsiya Proizvodstva (Mechanization and Automation of Production), No. 5, Moscow, May 1960, pages 1-4.7

Over-all mechanization and automation of production processes is regarded by the Communist Party as the principal means toward technological progress, without which a rapid pace of further rise in labor productivity would be impossible.

The revised Long-Range Plan of Development of the New Technology for 1959-1965 for the enterprises of the Moscow City Sovnarkhoz envisages a further increase in the number of over-all mechanized and automated types of production, shops and departments to 139 from 78, and the creation of 27 over- all mechanized and automated enterprises as well. In addition, measures drafted pursuant to the Resolution of the June (1959) Plenum of the CC CPSU provide for introducing during the seven-year period the over-all mechanization and automation of production, shops and departments. Thus, 32 enterprises and 212 individual types of production, shops and departments with over-all mechanized and automated production processes will be created in the Moscow City Sovnarkhoz during the seven- year period, and 182 (75 percent) of the total number of these objects will be created within the first four years of the seven-year period.

The characteristics of the model production objects and the schedule for their introduction during the seven-year period are cited in the Table below.

Major measures are being conducted by the crew of the Likhachev Automobile Plant to convert it into a model enter- prise at which over 90 percent of all operations will be con- ducted according to mechanized and automated cycles. In this connection, that plant will manufacture new, more economical trucks whose use will yield savings of about one billion rubles (in the yearly output of automobiles) to the national economy.

The 1GPZ /First State Bearing Plant7 should organize during the seven-year period five automatic shops for the pro- duction of ball and roller bearings, which will make it pos- sible to manufacture over 80 percent of all bearings without using manual labor.

Наименование объектов	Всего за 1959—1965 гг.	Внедряется по годам						
		1959	1960	1961	1962	1963	1964	1965
Предприятия . .	32	1	4	10	6	5	5	1
Производства .	21	1	3	2	3	8	4	—
Цехи	75	6	14	25	18	9	2	1
Участки	116	14	15	38	22	18	9	—
Итого . .	244	22	36	75	49	40	20	2
В % .	100	9,2	14,7	30,6	20,1	16,4	8,2	0,8

Table

1. Object; 2. Total for 1959-1965; 3. Year of Introduction; 4. Enterprises; 5. Types of Production; 6. Shops; 7. Departments; 8. Total; 9. In percent.

The Hard Alloys Combine has begun to carry out the over-all mechanization and automation of basic and auxiliary processes of the production of hard alloys, to be completed by 1963 and to result in the introduction in all technological departments of highly productive equipment and progressive technological processes -- among others, hydrogen reduction of tungsten, vibrational grinding of mixtures, drying of semifinished products by infrared rays, vacuum sintering of alloys, and, in addition, application of the newest achievements of radio electronics, photo-engineering, and ultra-sonics. The conduct of the above measures will ensure the doubling of the volume of output of hard alloys at the Combine.

The enterprises of the Sovnarkhoz are establishing two model types of welding production -- one at the Likhachev Automobile Plant, and the other at the "Kompressor" Plant. The assembling and welding of products will be conducted on continuous-flow mechanized lines, which will make it possible to increase the volume of output and to elevate greatly the general production level.

Over-all mechanization and automation are being introduced in the most labor-consuming sectors of industry, especially in the sector of the production of various types of castings. The related work is being conducted on a large scale in two iron casting plants: the "Stankolit" and the Plant imeni Voykov. These plants are being modernized and they will adopt the over-all mechanization and automation of the production of iron castings for machine building and iron heating radiators. In addition, 11 casting shops in, among others, the "Dinamo," imeni Vladimir Il'ich, and "Izolit" plants, will be included into the number of model production objects.

Considerable attention will be devoted to introducing the over-all mechanized and automated processes of assembling, and for this purpose it is expected that 20 model assembling shops and departments will be set up in various branches of industry. The over-all mechanization and automation of production extends to the enterprises of every branch of industry.

In two large furniture-assembling combines alone, 40 automatic lines and approximately 900 special machine tools will be activated.

A great part of the concrete measures taken to fulfill the resolutions of the June Plenum of the CC CPSU pertains to the introduction of new technological production processes ensuring a rise in labor productivity and improvement in the quality of production. Plans exist for introducing over 500 up-to-date technological processes for the fabrication of new products.

To eliminate arduous manual labor, the introduction of

continuous transport will be fostered; such transport will include start-stop conveyers with programmed control ensuring the delivery of loads to their destination according to a program pre-set from the control panel.

The outlays on materializing the measures for the over-all mechanization and automation of enterprises, types of production, shops, and departments, for the Sovnarkhoz as a whole are tentatively estimated at a total of 2,259 million rubles, and the nominal-yearly savings to ensue from these measures -- at 1,813 million rubles. Thus, all expenditures will be recouped within 1.2 years.

The economic effectiveness of over-all mechanization and automation is illustrated by the following examples.

The Small-Displacement Car Plant in Moscow is introducing the over-all mechanization and automation of computational and analytic operations in industrial management which will make it possible to improve the efficiency of performance of the engineer and technician cadres and more than halve the numbers of the administrative and accounting personnel.

The conduct of measures to establish an over-all mechanized production of modern 1K62 screw-cutting lathes at the "Krasnyy Proletariy" Plant in 1960 will reduce by 30 percent the labor input involved in manufacturing the parts of these machines, and increase by 25 percent the plant's ouput capacity. While the outlays on conducting these measures will amount to 19 million rubles, the resulting savings will amount to 7.5 million rubles /a year/.

At the "Kompressor" Plant the over-all mechanization of the production of unified compressors will yield an annual saving of seven million rubles, and it will cost 10 million rubles. The mechanization of the welding production of refrigeration equipment at the same plant will cost 15 million rubles and yield savings of 20 million annually.

At the "Frezer" Milling Tool Plant, the over-all mechanization and automation of the production of drill bits, screw taps, threading dies, and blades for milling cutter will cost 57 million rubles and yield annual savings of 25 million rubles.

At the "Dinamo" Plant the over-all mechanization of the production of a-c motors will cost 12.5 million rubles and yield annual savings of approximately seven million rubles.

The Transformer Plant will expend 1.2 million rubles on the mechanization of the production of midget transformers and thereby attain savings of 1.7 million rubles a year, i. e., here recoupability will be ensured within eight or nine months.

Particularly interesting are the figures on the savings attainable at the "Moskabel'" Cable Plant. There, over-all mechanization will yield nominal-annual savings of 240 million rubles at a cost of 83 million rubles, i. e., all outlays will

be recouped within less than an half year.

Success in solving the tasks as to the creation of over-all mechanized production processes and exploration of progressive technological processes hinges on mobilizing the co-operation of the scientific research institutes and special project-design and technological organizations in Moscow, and, in addition, on the expansion of the existing technical services in enterprises and the establishment of new specialized design and technological bureaus, texting bases, laboratories, and centralized types of production.

At present over 150 organizations are working in this direction and providing considerable assistance in the work on both the designing of production departments, shops and enterprises and the development of structures, means of mechanization and automation, and nonstandard equipment.

In this connection it is worthwhile to mention the initiative of the Scientific Research Institute of Aviation Technology (NIAT), which undertook to provide assistance to the Sovnarkhoz's enterprises with regard to creating 18 automatic lines and 62 machine tool assemblies based on standardized units during the seven-year period.

Recently a team of scientists at the MVTU im. Baumana /Moscow Higher Technical School imeni Bauman/ had joined the work on perfecting the fabrication of plastic products. They adopted concrete pledges to implement, in cooperation with plants, a large number of tasks, and they specified the hours at which they are available for consultation in their offices to any worker of any Moscow enterprise or organization.

To consolidate and expand in the enterprises the technical services for designing the means of the mechanization and automation of production, the Sovnarkhoz has enlarged the existing design bureaus for mechanization, technological services, laboratories, and institutes, and in addition it has established 47 new design bureaus for the mechanization and automation of production processes and 45 technological and technical bureaus and divisions.

While working on over-all mechanization and automation, the Sovnarkhoz explores and develops improved technical solutions ensuring an effective application of the achievements of science and engineering. Thus, on examining the project for an automated shop for the production of Cardan bearings at the First State Bearing Plant, the Sovnarkhoz furnished a penetrating analysis of the shortcomings of that project and outlined the principal trends which should be followed in the designing of over-all mechanized and automated objects for any branch of industry.

These trends should be described in some detail, because this is of great importance to improving the economic

effectiveness of the general level of production. Primarily, the Sovnarkhoz pointed to the necessity of materializing mechanization and automation solely on the basis of new, progressive technology.

Special attention should be devoted to the use of the modern means of intra-shop transport and, preferably, various types of continuous /conveyer/ transport, on utilizing for this purpose the upper parts of premises.

In the course of the conduct of the over-all mechanization of production it is necessary at the same time to elevate the level of the organization of production and labor through a broad mechanization and automation of computing-planning and dispatcher work, automation of control and regulation of production processes.

Special attention should be devoted to creating conditions that would exclude air pollution, on using for this purpose facilities equipped with means for diverting dust, harmful vaport, etc., and moreover it is necessary to mechanize the maintenance of buildings and floors and the washing of windows and skylights of production premises.

To materialize the intended work on the over-all mechanization and automation of production processes, Moscow's enterprises will have to introduce 1,063 highly productive automatic, semiautomatic and continuous-flow-mechanized lines, 14,000 equipment units with automatic and semiautomatic cycle of performance, and over 30,000 diverse automatic instruments and devices. In addition, plans exist for the modernization of over 30,000 units of metal-cutting and metal-working equipment.

A considerable part of that equipment will be interconnected by means of transport and rigged out with loading devices and active-control instruments and thus converted into automatic and semiautomatic lines. Then the productivity of the modernized equipment will be increased twofold to fourfold if not more.

The enterprises and organizations of the Moscow City Sovnarkhoz had accomplished in 1959 a great deal of work on the creation of new machines, mechanisms, equipment, instruments, materials and products and on the industrial introduction of the achievements of science and engineering, mechanization and automation of production, elimination of arduous manual operations, and introduction of highly productive technological processes.

Last year over-all mechanization and automation of production processes were introduced at one enterprise, in eight shops, and in 26 production departments. During the same period 18 automatic and semiautomatic lines and 162 continuous-flow mechanized and conveyer lines, or 25 more than originally

planned, were also introduced. Approximately 2,100 automatic and semiautomatic lathes and group machine tools and special machine tools were installed, and so were approximately 4,500 running meters of conveyers and other continuous-transport equipment. The level of mechanization of forming operations in casting shops was raised to 85 percent against 78 percent in 1958.

Over-all mechanization and automation were introduced in the precision casting operations in two plants, which made it possible to increase several times the yearly volume of casting from the same production space, to reduce the production cost per ton of acceptable castings to nearly a third, and to reduce the number of workers 2.5 times. All the related expenditures were recouped within a year.

The conduct of the over-all mechanization of the production of a-c motors for cranes at the "Dinamo" Plant involved the introduction of conveyerized assembling and the mechanization of the process of the electric quality control testing of motors in sizes I to IV on the conveyer. In this connection labor productivity in assembling rose by 40 percent, and in testing -- by 25 percent.

The Low-Voltage Equipment Plant has mechanized its process of assembling 20 types of electrical equipment. Upon the activation of an intermittent-flow conveyer line labor productivity per worker rose by 60 percent, production cost dropped by 22 percent, and dozens of meters of production space were freed.

The following have been industrially introduced: automatic lines for the successive vacuum deposition of bismuth and selenium onto aluminum sheets; an automatic line for the mechanical working of the casings of wrist watches at the Second Watchmaking Plant; a mechanized conveyer line for the assembling of watches at the First Watchmaking Plant, etc. All these lines are rigged with mechanized attachments and devices for active control of the quality of the executed operations, and they display extremely high technical and economic indexes. Thus, e. g., the line for assembling watches has reduced by 190 hours the labor input required per 1,000 products, and cut the number of workers by 33 persons.

The High-Voltage Systems Administration of the Noginskiy Rayon became Moscow's first enterprise with over-all automated and telemechanized production processes. As a result of the measures conducted, the entire management of that rayon's high-voltage systems was totally automated as early as in 1959. The round-the-clock duty personnel which had been employed until very recently in all 36 stations of the rayon, has now been dispensed with. The automation of the systems-management processes has considerably improved the reliability of the

supply of electrical energy to enterprises and it has ensured a greater operativeness of the performance of the power systems. The number of tending personnel was reduced 3.5 times.

Very important work was accomplished in mechanizing the varnishing of die-stamped /rubber/ overshoes, through the introduction of a special installation at the "Krasnyy Bogatyr'" Plant. That original installation, based on the use of electrostatic varnish sprayers, and rotating at the rate of 1,000-1,500 RPM, eliminates arduous and unsafe manual labor and makes it possible to direct the varnishing process by remote control from a central control station. This operation used previously to be conducted manually by female workers.

Electronic computer engineering is being more and more widely utilized in the Sovnarkhoz's industry. At the beginning of 1959 the "Krasnyy Bogatyr'" Plant had installed for the very first time in the indigenous industry a "Mars" type electronic computer for the control and regulation of the techno-logical processes of the vulcanization of rubber footwear on presses. That first computer was designed for controlling and regulating temperature, time and pressure simultaneously on 48 presses at 144 points. The operation of that machine relieved a great number of servicing personnel, improved substantially the quality of production, and yielded over 5.5 million rubles in savings. At present the same plant is installing another computer of this kind, which will service 66 presses at 198 points and will thus complete the automation of the control and regulation of technological processes during the vulcanization of footwear.

Progress has been achieved in developing such pace-setting processes as the continuous-flow peroxide-steaming method of bleaching textiles, and wrinkleproofing and shrinkage-proofing finishing of staple and viscose fabrics by using artificial resins. These methods were used in producting over 80 million meters of diverse high-quality fabrics last year.

Also conducted was the automation of the weaving industry through the replacement of obsolete equipment by new, more productive equipment. As a result of this measure alone, 60 persons were relieved in the "Krasnaya Roza" and Shcherbakov combines, and 84 persons, at the Frunze Weaving Mill. The yearly savings yielded by these measures exceeded 1.5 million rubles.

The "Bol'shevik" Confectionery Plant has introduced a line mechanizing the production and packaging of cocoa, coffee, and their products. This made it possible to relieve eight workers previously occupied with the manual packaging of these products, and to transfer them to other occupations. The "Krasnyy Oktyabr'" Confectionery Plant has introduced a machine mechanizing the wrapping of truffle-type candies, which relieved

16 workers. The "Udarnitsa" Confectionery Plant has activated an installation mechanizing the processes of marmalade production. This installation relieved 12 workers and yielded a saving of over 300,000 rubles.

The target figures of the Seven-Year Plan for the USSR envisage the designing and activation of 1,300 automatic lines for the enterprises of the country's metalworking industry, with 400 of these lines to be built by the Moscow City Sovnarkhoz.

This is a very great task, whose solving requires the conduct of major organizational and technical measures for a proper development of the design of the future automatic lines and for creating the capacities for their production.

It is sufficient to mention that during the preceding seven years the Moscow machine tool plants built a total of 42 automatic lines, whereas, according to the Seven-Year 1959-1965 Plan, this figure is to be exceeded more than tenfold.

The expansion of the design and production of automatic lines in view of such a high output target can be conducted successfully only on the condition of a broad application of highly productive technological and organizational principles of large-serial and continuous-flow production to the manufacture of standard parts, units and machine tools. And for this purpose it is necessary to:

(1) Conduct work on the specialization of enterprises on the basis of a broad unification and standardization of the parts and units of the metal-cutting machine tools composing the automatic lines;

(2) Develop designs of metal-cutting machine tools adapted to the make-up and degree of automation and suitable for incorporation in automatic lines;

(3) Develop unified designs of transporting, loading, receiving, and other auxiliary devices;

(4) Develop and standardize accessories for control panels and control instruments ensuring automatic methods of measurement.

The work on the unification and standardization of the units and parts of machine tools conducted by our special design bureaus (SKB-1, SKB-6 and the Design Bureau at the Plant imeni Ordzhonikidze) has made it possible to develop the organization of the production of automatic lines by mobilizing a large number of enterprises and taking into account the establishment in these enterprises of a centralized production of standardized units of machine tools, hydraulic, electric and pneumatic devices, and automatic control devices, and, in addition, the assembling of machine tools and subassemblies

suitable for incorporation into automatic lines.

Altogether, for this purpose, the Moscow City Sovnarkhoz has mobilized 10 plants of which three (imeni Ordzhonikidze, "Stankoliniya," and "Stankoagregat") will be the main enterprises for the assembling of automatic lines from standardized units and parts and testing their performance prior to their consignment to customer enterprises.

Considering the great volume of work on the production of automatic lines, three additional plants previously not manufacturing products for machine tool building have been mobilized for this purpose. They are the "Stankoliniya" (former "Pod'yemnik" Plant), the "Stankoagregat" (former "Stal' most") and the "Spetsstanok" (former "Strommahina"). The previous production in these plants is being discontinued. This will make it possible to increase the share of advanced machine tool building in the industry of Moscow at the expense of discontinuing the metal-consuming production of lifting cranes in Moscow.

Stable production ties have been established among all ten of the plants, on the basis of cooperation in technology, machine parts, and objects, and this should ensure the solving of the task of increasing the national economy's output of automatic lines for the metalworking industry. As part of the preparations for the June Plenum of the CC CPSU the workers of the Sovnarkhoz's machine tool industry have utilized additional reserves and adopted Socialist pledges for producing 450 automatic lines during the seven-year period.

The measures drafted by the Sovnarkhoz, and the pledges of the enterprises as well, provide for developing machine tool building and, in particular, increasing the output of special machine tools 2.2 times more than planned for the seven-year period, and particularly increasing 2.3 times the output of precision machine tools for the finishing operations of the technological process.

The "Kalibr" Plant will organize the production of control and measuring instruments and automatic control and measuring devices for incorporation into automatic lines, so as to attain in 1962 an output of these instruments and devices to the extent of 32 million rubles.

The Low-Voltage Equipment Plant will discontinue in 1960-1961 its production of uncomplicated electrical equipment and organize the production of various electrical equipment needed for automatic lines.

The Plant imeni Kalinin is setting up the specialized production of hydraulic equipment. The Accessories Plant is beginning to specialize in the production of pneumatic equipment. The "Krasnyy Proletariy" Plant will continue the continuous-flow production of lathes -- but lathes of a new design

suitable for incorporation into automatic lines. In addition, the last-named plant will manufacture special-purpose and specialized automatic and semiautomatic lathes for incorporation into the automatic lines for the production of crankshafts, distributing shafts, and various types of rolls.

The "Spetsstanok" Plant begins to specialize in the output of power heads, carriages, and special-purpose machine tools designed for automatic lines. The "Stankoagregat" Plant, aside from its principal production of automatic lines, machine tool groups and special-purpose machine tools, is beginning to organize the specialized production of welded workbenches, carriage slides, electric cabinets, and other welded products. The "Stankoliniya" Plant will manufacture automatic lines, special-purpose machine tools, and accessories for automatic lines. The Plant imeni Ordzhonikidze will continue to specialize in the production of automatic lines, automatic and semiautomatic lathes, machine tool groups, and semiautomatic milling-centering machines. The Grinding Machine Plant will manufacture special-purpose machine tools suitable for incorporation into automatic lines.

It should be noted that during the present seven-year period Moscow plants will manufacture automatic lines for machining both stationary (casing) parts and moving parts of the rotating-body type.

In view of the high costs of automatic lines, Moscow machine builders keep in mind the following three fundamental requirements when designing automatic lines.

First, automatic lines should be designed only for progressive technological processes, and hence their designing should be preceded by studies of the technological processes in best enterprises, utilization of the achievements of modern science, and conduct of the necessary experimental work.

Second, automatic lines should be designed for easy conversion without resorting to the alteration of most of their standard units, in the event of a change in the production profile of the enterprise in which they are installed. Consequently, the degree of standardization should be sufficiently high and reach 80-90 percent of the composition of the equipment composing the automatic line.

Third, the automatic lines for machining parts of the rotating type should be easily adjustable from one type size to another (within the limits of the established range of sizes).

To solve the great number of complex problems involved in the creation of automatic lines and numerous special-purpose and group machine tools, it is necessary to expand considerably the existing design bureaus and to establish new ones and to provide these bureaus with laboratories and

experimental shops.

For this purpose the Sovnarkhoz has provided for increasing the personnel of design services by 900 persons and, in addition, for expanding five existing laboratories and establishing 15 new ones and five experimental bases.

There is no doubt whatsoever that the crews of the enterprises of the Moscow City Sovnarkhoz shall implement and greatly surpass all the tasks of the Seven-Year Plan.

b. Computer for Automating the Computation of Cupola Furnace Charge

The introduction of computer engineering into the automatic guidance of production processes places in the forefront the problem of designing specialized computers for use within narrow fields of technology.

One such machine is the computer for automating the computation of cupola furnace charge, which was developed at the Tbilisi Scientific Research Institute of Instruments and Means of Automation (TNIIPSA) in 1957-1958. The problem of computing the charge consists in determining the correct mutual proportions of the charge materials to be charged into the cupola furnace, proportions as would ensure the desired chemical composition of the smelted-out pig iron. A number of branches of the machine building industry uses high-quality iron castings containing several alloying elements. Such a composition of iron requires the introduction of 9 or 10 grades of different materials into the charge. The computations conducted under industrial conditions require labor-consuming arithmetical calculations or the solving of algebraic equations with several unknowns.

To reduce the volume of calculations, the graph method of charge computation is often used in practice. With an increasing number of unknown variables this method becomes so complicated as to be no longer practical.

The automation of the computing process by means of a specialized computer makes it possible to compute under industrial conditions a charge containing as many as 10 different components with a practically sufficient accuracy within as little as a few minutes. In the general case the mathematical task is reduced to solving a set of ten linear algebraic equations of the type of:

$$\sum_{k=1}^{10} a_{ik}x_k = 100a_i, \quad i = 1 \ldots 10, \qquad (1)$$

in which connection

$$a_{ik} \equiv 0 \text{ for } i = 6, \ k = 1 \ldots 5;$$

$$a_{ik} \equiv 1 \text{ for } i = 10, \ k = 1 \ldots 10,$$

where the coefficient a_{ik} denotes the percentile content of chemical elements (carbon, lead, manganese, etc.) in the charge components, the coefficient a_i denotes the percentile content of analogous elements in the charge, and the coefficient x_k denotes the amount of a given charge material needed per 100 kg of charge in order to obtain iron of the desired chemical composition.

The values of the a_{ik} coefficients are taken from the data of the chemical assay of charge materials.

The values of the a_i coefficients are subject to computation according to monotype formulas:

$$a_i = b_i \ \frac{100}{100 \pm y_i} \ \%, \qquad (2)$$

where b_i denotes the percentile content of a given element in the smelted iron (according to grade of the iron) and y_i denotes the loss (-) or sticking (+) of the given element in the course of smelting (determined experimentally for every cupola furnace).

A transformer scheme proposed by R. Mellok was chosen for solving the set of equations (1). That scheme is distinguished by its high reliability and it makes possible a rapid and accurate verification of the solution.

The automatic computation of the losses of given elements in the course of smelting is materialized in the machine by means of an electric bridge circuit realizing eq. (2).

The final results of charge computation are automatically printed on paper tape in the digital-printing unit. A provision has also been made for the direct measurement of voltage levels on the natural scale (1 kg -- 1 volt) by means of a measuring instrument with a dial graduated directly in kg. The outer view of the computer is depicted in Fig. 1, and the block diagram of the computer -- in Fig. 2.

The solving unit contains ten main coefficient transformers and one transformer of absolute terms.

The coefficient transformers are executed of toroidal cores with a 30-mm internal diameter and a six cm^2 cross-sectional area of steel.

The number of coefficient windings in every main transformer corresponds to the number of coefficients other than zero in every column of the matrix. In addition to tapped
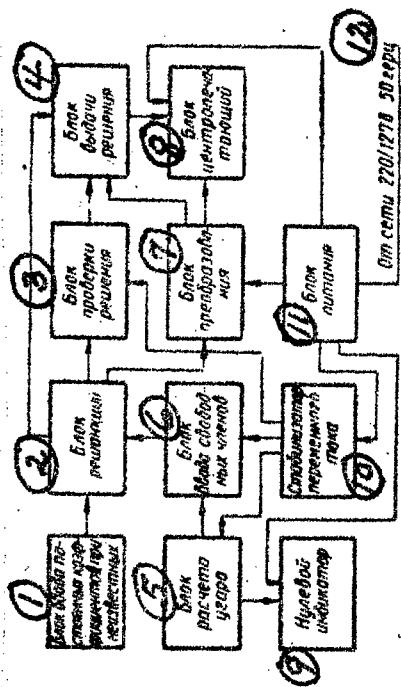
1. Unit for Interpolating Constant Coefficients in the Presence of Unknowns
2. Solving Unit
3. Solution-Verifying Unit
4. Solution-Issuing Unit
5. Unit for Computing the Loss of Charge Components
6. Unit for Introducing Absolute Terms
7. Converting Unit
8. Central Printing Unit
9. Zero Indicator
10. A-C Stabilizer
11. Power Supply Unit
12. From 220/127 volt, 50 cps system

Fig. 2. Block Diagram of the Computer

windings, these transformers are provided with two nontapped windings; a measurement winding and a "unity" winding.

The transformer of absolute terms is a two-winding one. It consists of two tapped windings and is connected to the circuit as an autotransformer. The first winding is the main one and it is used in the solving unit. The second winding is the auxiliary one, and it is used in the digital conversion unit.

All the coefficient windings pertaining to one and the same row of equations are connected in series with each other and with a part of the main winding of the transformer of absolute terms. The number of turns in each section of the coefficient transformer expresses on a fixed scale the corresponding constant control factor of the given system, and the number of turns in the winding of the auto-transformer -- the magnitude of the absolute term.

The autotransformer is excited by alternating current of a stabilized voltage, from a special power supply unit. The measurement windings of the coefficient transformers are connected to the input of the digital conversion unit or to a phase-sensitive voltmeter with a high-resistance input for direct measurement. The voltages on the ends of the measurement. The voltages on the ends of the measurement windings are proportional to the magnitudes of the variable values of x_k in the given set of equations.

Special two-decade switches are used to select the coefficients expressed by the definite number of transformer turns.

The switches are mounted on the patch bay of the face panel of the machine, on which are mounted an operating mode switch, two measuring circuit switches, and ten switches for selecting the problem in the "verification" mode.

The operating mode switch has three positions: "computation," "verification," and "printing."

The "computation" mode involves the conduct of the direct measurement of the constant levels of voltages corresponding on the natural scale to the weight of each of the charge components.

During the "printing" mode of operation, the output circuits of the solving unit are connected to the digital conversion and printing units.

The "verification" mode is carried out by selecting, by means of ten special switches (one each for every charge component), the voltage levels proportional to the magnitudes of the variables determined during the "computation" or "printing" mode. When the operating mode switch is adjusted to the "verification" position, the scheme is commutated in such a manner that the transformers become excited by voltages proportional to the magnitudes of the corresponding variable

values of x_k. The coefficient windings, connected in series for every row of equations, become successively connected to the measuring instrument which measures on a fixed scale the sums of

$$a_i' = 0{,}01 \sum_{k=1}^{10} a_{ik} x_k'.$$

A comparison of the results of measurements with the magnitude of the absolute terms for the corresponding rows of equations serves to determine the errors of the first-approximation solution in the "computation" and "printing" modes.

The positions of the operating mode switch are registered by signal lamps, one each for every mode. A fourth signal lamp corresponds to a "no solution" state of the scheme. It is turned on automatically by the contacts of the relay of the phase-sensitive voltmeter in the event of a 180-degree phase shift between voltages on measurement windings, which corresponds to the presence of a negative root in the starting set of equations. This signifies that it is not feasible to use the selected components with a given chemical composition for obtaining a mix for smelting iron of the desired grade.

The selection of charge components, i. e., the selection of this or that transformer corresponding to a given x_k-variable, is conducted by means of ten throw-over switches. A turn of the toggle of a switch serves to close the circuit of the signal lamp illuminating the numeral of the corresponding transformer. One such signal lamp is mounted above each vertical row of coefficient switches. This is accompanied by the activation of the transformer-winding circuits participating in the analog computation of the last row of the set of equations $\sum x_k = 100$. The transformers whose numerals are not illuminated do not participate in the solving of the set of equations and all their windings are shortcircuited.

The selection of the number of turns per unit of constant coefficients and absolute terms of equations is conducted in such a manner as to avoid transformations of equations while ensuring the necessary accuracy of solution and, in addition, to obtain a solution on the natural or pre-selected scale convenient for measurements.

The computation of transformers was conducted on the basis of special methods based on the assumption that leakage fluxes and losses are absent in copper and steel -- an assumption which is close to reality. According to these

methods, the following relationship exists between the scale coefficients and principal parameters of the transformer scheme:

$$U_O \frac{n_2}{n_1} \cdot \frac{W_s}{W_O} = m, \qquad (3)$$

where m is scale on which the solution of equations is obtained;
U_O is voltage of the excitation winding of the absolute-term transformer;
W_s is number of turns of the measurement windings of coefficient transformers;
W_O is number of turns of the excitation winding of the absolute-term transformer;
n_1 is number of turns per unit of coefficients a_{ik};
n_2 is number of turns per unit of the coefficient expressing the absolute term $100a_i$.

In the event the solution is computed on the natural scale (1 kg = 1 volt), expression (3) assumes the form of:

$$U_O \frac{n_2}{n_1} \cdot \frac{W_s}{W_O} = 1. \qquad (4)$$

In the experimental model of the computer for the automatic computation of charge, these parameters have the following values:

$$m = 1; \; U_O = 30 \text{ volts};$$
$$n_1 = 3; \; n_2 = 0.02;$$
$$W_s = 900; \; W_O = 180.$$

An analysis shows that in order to reduce the magnetizing current of transformers it is expedient to take the largest possible ratio of scale coefficients $\frac{n_1}{n_2}$. Thus, the accuracy of the determination of the roots of equations will be higher.

The unit for computing the loss of charge components consists of six bridges whose arms are represented by resistors corresponding on a fixed scale to the coefficients of formula (2).

The arms of each bridge constitute wire-wound resistors of constantan wire, wound by the noninduction method onto an insulating frame. The magnitudes of resistances are regulated by means of two-decade switches of the same design as the switches of the solving unit, mounted on a common axis together with the switch for selecting the absolute term of the transformer

scheme.

In the process of the balancing of the bridge, the human operator, on turning the adjusting disk of the last-named switch, selects the a_1-coefficients on the bridge circuit. This is accompanied by the commutation of the contacts related to the absolute-term transformer, and the same a_1-coefficient is selected on that transformer. Such a device ensures the automatic transfer of the coefficients found on bridge circuits as a result of the computation of the loss of charge components, into the transformer circuit conducting the computation of the charge. The bridge is powered by a 30-volt alternating current.

To the measuring diagonal of the bridge is connected an adjustable voltage divider whence a signal proceeds via a coupling capacitor to the first 6Ye5S indicator tube and, at the same time, to the grid of the 6S5S amplifier tube. The amplified signal proceeds toward the second 6Ye5S indicator tube. The tuning according to the first indicator tube yields the magnitude of the first sign of the coefficient a_1 ("roughly"), and the tuning according to the second indicator yields the magnitude of the second sign ("precisely").

The indicator device is a general one for all six bridges, and the connection of this or that bridge circuit to the indicator is achieved according to the wish of the human operator by pushing a button mounted on the face panel. A mechanical block system ensuring the connection of not more than one button at a time is installed in the same area on the panel.

The digit printing unit consists of an electromagnetic pulse counter with a printing mechanism which makes it possible to print on paper tape a two-sign number automatically picked up by the counter on receiving the corresponding pulses from the conversion unit. The design of the conversion unit is based on the step-relay scheme (Fig. 3).

The device serving to convert fixed voltage levels into coded digits and then to print these digits is based on the compensation method of measurement, materialized step by step, by the rise of the compensating voltage from the zero. The magnitude of the individual step here is, according to the desired accuracy of performance of the device, taken to be equivalent to one volt.

For the above method of measurements, the number of steps-pulses conducted until the onset of full compensation will be equal to the magnitude of the sought-for voltage in volts.

The operation of the step-by-step selectors of "unities" and "tens" providing the compensating voltage is accompanied by the operation of the digital code wheels of the digit-printing counter. At the instant when the equilibrium is
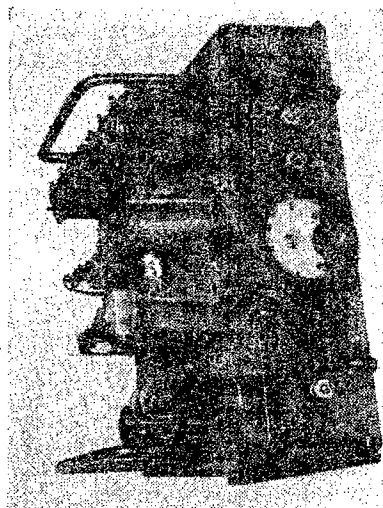
Fig. 3. Digital Converter

restored in the compensating circuit, the necessary number forms on the digital code wheels and is thereupon directly printed.

The voltage-compensating source changing from 0 to 100 volts in gradations of one volt is constituted by a special winding on the absolute-term transformer in the solving unit, having lead-outs in gradations of one and ten volts (the starting point of this winding is the common point between the "unity" and "ten" lead-outs).

The digit printing counter consists of the following principal units (Fig. 4).

1. Digital code wheel unit, which contains three digital code wheels -- one each for "unities," "tens" and "ordinals." The "unity" wheel is provided with a ratchet mechanism actuated by an electromagnet receiving pulses from the converter unit.

The transmission of pulses to the digital code wheel for "tens" is conducted mechanically by the code wheel for "unities." The ordinal digital code wheel serves to reprint the ordinal number of the consecutive charge component. The /tape imprinted with the/ readings of the digital code wheels for "unities" and "tens" is issued mechanically and directly after printing.

2. Single-revolution-coupling unit, containing couplings by means of which the driving shaft of the printing device executes one revolution during every printing cycle.

The single-revolution couplings bring about a short-lasting connection of the digit-printing unit to its motor, which lasts throughout the printing time.

In addition to the above-mentioned two principal units, the digit-printing counter contains elements conducting such operations as the moving of the paper tape and of the printing ribbon and the cutting and discharge of the printed tape.

The directing pulses from the converter unit to the digit-printing unit proceed only from the balance relay and, in the opposite direction, from the programming device.

During the joint testing of the converting device and the digit-printing device the pulse rate was raised to 10 steps a minute. This had yielded fully satisfactory results.

The inclusion of the converting and digit-printing units into the computer considerably increases the effectiveness of its use and yields great conveniences during the operation of the computer under industrial conditions.

The successful laboratory tests of the experimental model of the computer made it possible to begin its industrial introduction. For this purpose at the end of 1959 several
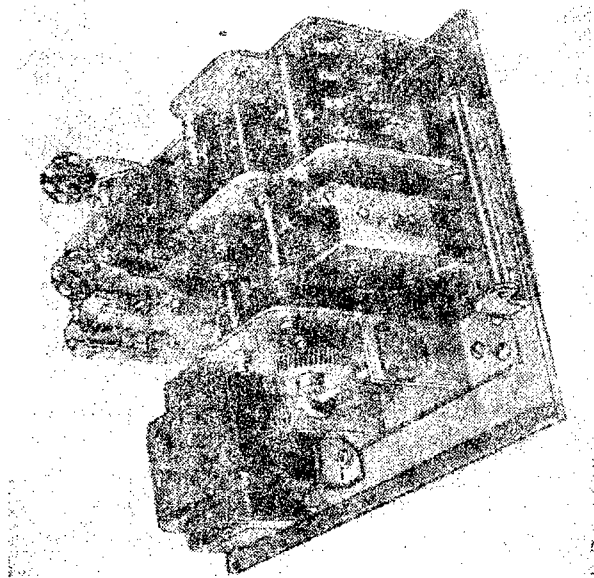
Fig. 4. Digit-Printing Counter

experimental specimens of such computer were transmitted to industrial enterprises.

c. Operation of Continuous-Action Equipment at Baydakovskiy Open-Strip Pit

/Following is the translation of an article by A. A. Chernegov entitled "Ekspluatatsiya Oborudovaniya Nepreryvnogo Deystviya na Baydakovskom Kar'yere" (English version above) in Gornyy Zhurnal (Mining Journal), Moscow, June 1960, pages 12-20.7

...Excavators Working in Tandem with Dump Conveyor Bridge

The SU-450 Bucket Wheel Excavator. This operates on the upper half of the conveyer-bridge-level terrace.

Initially the excavator was equipped with a bucket wheel of the half-open type, with each all-metal bucket having its own discharge chute. Since the discharge chutes and buckets became rapidly clogged with rocks when operating in moist loams, it was necessary to halt the excavator for cleaning several times during every work shift. The variable technical productivity of the excavator was therefore 1,000-2,000 m^3 lower per work shift than at operation in sandy rocks.

Brief Technical Characteristics of the SU-450 Rotor Excavator

Productivity	860 m^3/hour
Bucket capacity	450 liters
Scooping height	18 meters
Total weight	500 tons
Dimensions of excavator:	
Height	25 meters
Length	62 "
Width	17.8 "

...YeS-500 Multiple-Scoop Excavator. This excavator has a mechanism which makes it possible to turn its body together with the scoop frame by 230 degrees, which in turn makes it possible to work the terraces in the dead-end parts of the pit.

Brief Technical Characteristics of the YeS-500 Multiple-Scoop Excavator

Productivity	600 m^3/hour

Scoop capacity   500 liters

Scoop capacity	500 liters
Scooping height	15 meters
Traveling speed of excavator	8 meters/minute
Total weight	360 tons
Dimensions of excavator:	
Height	20.6 meters
Width	12 "
Length	47.5 "

D-500 Multiple-Scoop Bottom-Scooping Excavators. These work the bottom half of the conveyer-bridge-level terrace. They are analogous in design to the YeS-500 excavator. The scoop chain is activated by an independent drive, which was re-designed, as was the drive of the YeS-500 excavator.

Brief Technical Characteristics of the D-500 Excavator

Productivity	600 m^3/hour
Scoop capacity	500 liters
Scooping depth	16.5 meters
Traveling speed of excavator	7 meters/minute
Total weight	400 tons
Dimensions of excavator:	
Height	33 meters
Length	48 "
Width	18.5 "

...Shovels

The D-300 Multiple-Scoop Bottom-Scooping Shovel. It works the lower half of a coal seam varying in thickness from three to 10 meters. That half contains one to three interstrata of gangue, which are extracted separately.

The scoop frame of this shovel consists of four links and a leveling link. The extracted coal is conveyed via the discharge bin of the shovel into freightcars with capacities of 30 to 50 tons.

Brief Technical Characteristics of the D-300 Shovel

Productivity	365 m^3/hour
Scoop capacity	300 liters
Scooping depth	10 meters
Traveling speed	4.15 meters/minute

Weight	200 tons
Dimensions:	
Height	12 meters
Length	31.4 "
Width	13.5 "

During the mining of the interstrata the gangue is transferred by means of a gate valve onto a cross conveyer mounted in the frame of the shovel. Farther on the gangue proceeds onto the discharge conveyer which is connected to the shovel by brackets and which moves on the same rail tracks as the shovel.

A 900-mm gauge rail track for the passage of railroad trains is laid beneath the portal of the shovel in between the rails on which move the shovel's bogie wheels. All five rail tracks are laid on ties 5.5 meters long, which also serve as supporting bases for the metal poles of the electric-loco-motive contact system.

The D-300 shovel operates throughout the year except for one to one and one-half months of stoppage for repairs during the first quarter of the calendar year. During that repair period, the machine is replaced by a SE-3 excavator transferred from the upper overburden terrace or by a RS-350 bucket wheel excavator. In addition, the D-300 shovel is halted once a month for a day's repair (coinciding with the repair of the briquetting plant processing the coal extracted in the pit). Every day during the first work shift one to three hours are set aside for preventive repairs of the ex-cavator.

...The RS-350 Crawler Tread Bucket Wheel Excavator. It works the top half of a coal seam up to seven meters thick (generally, three meters thick). This top half also contains two to four interstrata of gangue. The extracted coal is transferred via the discharge conveyer and chute into freight-cars with capacities of 30-50 tons.

The luffing radius of the shovel's bucket wheel reaches four meters in the horizontal plane. In the course of its operation the bucket wheel was modified to conform with that of the SU-450 excavator.

Brief Technical Characteristics of the RS-350 Bucket Wheel Excavator

Productivity	
For coal	750 m^3/hour
For gangue	550 m^3/hour

```
Bucket capacity                    350 liters
Scooping height                     13 meters
Maximal radius of discharge         15   "
Maximal height of discharge          4.5 "
Possible angle of rotation         360 degrees
Traveling speed                      8 meters/minute
Weight                             227 tons
Dimensions:
    Height                          16.8 meters
    Width                           10     "
    Length                          36     "
```

The operating mode of the RS-350 bucket wheel excavator
is the same as that of the D-300 multiple-scoop shovel...

... Table 2.

Technical and Economic Indexes of the Baydakovskiy Coal Pit

Index	Year			
	1956	1957	1958	1959
Coal Extraction in the Pit, thousands of tons	2554	2940	2831	2662
in which: by D-300 shovel and RS-350 excavator	1438	1641	1321	2207
Mean Daily Productivity of Pit, in tons of coal	6978	8087	7801	7376
Production cost per ton of Coal per Sector, in rubles and kopeykas	5-66	5-71	5-85	6-62

The technical and economic indexes of the extraction
excavators are cited in Table 2. The RS-350 excavator and D-300
shovel are not used to full capacity. Their loading is limited
by, on the one hand, the yearly target as to the extraction
and marketing of coal and, on the other, the presence of
readied reserves, i. e., the productivity of the overburden-
stripping equipment. The daily productivity of the D-300
multkple-scoop shovel usually amounts to 3,000-4,500 tons of
coal, and in isolated instances as much as 6,000 tons. The

daily productivity of the RS-350 bucket wheel excavator varies from 2,000 to 5,000 tons of coal.

The yearly volume of the gangue extracted by the D-300 and RS-350 machines amounted to 205,000-271,000 and 168,000-399,000 m^3, respectively.

The D-300 and RS-350 machines are serviced by teams of three persons per shift, consisting of: excavator operator, operator's assistant, and mining worker.

The Multiple-Scoop Dumpyard Shovel

The A-400 shovel is designed for receiving overburden rock from railroad trains and depositing rock on the dump heaps.

Brief Technical Characteristics of the A-400 Multiple-Scoop Shovel

Productivity	650 m^3/hour
Scoop capacity:	
Main-frame scoop	400 liters
Leveling-frame scoop	100 liters
Discharge radius (Maximal)	40 meters
Discharging height	15 meters
Traveling speed	5.5-9.15 meters/minute
Weight	250 tons
Dimensions:	
Height	9 meters
Length	60 "
Width	7.5 "

The leveling frame with the scoop chain and independent drive is suspended by ropes on the bracket boom of the shovel. That frame is designed for preparing the area for the subsequent laying of rail tracks.

Usually the A-400 shovel extracts 6,000-7,000 m^3 of rock daily, and in isolated instances its daily output reaches 12,000 m^3. Its productivity totaled 1,623,200 m^3 during the year 1959.

The stoppages of the A-400 shovel for repairs are usually scheduled for the winter-spring period when the maintenance of railroad sidings in normal state becomes particularly difficult.

...The A-400 dumpyard shovel displays no advantages over the operation of the single-bucket excavators used on dumpyards.

d. Excavators at the Novo-Kramatorsk Machine Building Plant

/Following is the translation of an article by P.
I. Slizkiy entitled "Ekskavatory Novo-Kramatorskogo
Mashinostroitel'nogo Zavoda" (English version above)
in Gornyy Zhurnal (Mining Journal), Moscow, June
1960, pages 53-54./

To satisfy the growing demand of open-strip pits for
large single-bucket excavators, the Novo-Kramatorsk Machine
Building Plant imeni Stalin will, in addition to the ESh-4/40,
ESh-6/60, and EVG-15 excavators which it is currently producing,
start in 1960 the production of the new ESh-8/60 and EVG-3565
excavators and switch to the serial production of the ESh-4/40M
excavators.

A comparison of the characteristics of these machines
is provided in the table below.

At present the plant is engaged in mastering the pro-
duction of buckets with a higher capacity -- 8 and 10 m^3 --
for use in its ESh-6/60 and ESh-8/60 machines, respectively.
Design work is in progress on increasing the capacity of the
buckets for the EVG-15 and EVG-3565 excavators to 20 and 40
m^3, respectively.

The ESh-4/40M and ESh-8/60 excavators were designed on
the basis of the serially produced ESg-4/40 and ESh-6/60 ex-
cavators upon taking into account the experience gained in
their operation. Individual drives for all mechanisms are
used in the new excavators.

While weighing nearly as much as the ESh-6/60 excavator,
the ESh-8/60 excavator is 30 percent more productive. This
was achieved thanks to a broad employment of low-alloy steels
in the metal carrying structures and lightweight alloys in
the auxiliary structures.

The EVG-3565 excavator is the world's largest in its
linear parameters (cutting radius and discharging height; it
surpasses greatly the large American excavator Marion-5760.
The sizable linear parameters of this machine make it possible
to use it for conducting overburden-stripping work with dis-
charge of gangue directly into the worked-out space without
any additional re-excavation. The EVG-3565 excavator has
been provided with automatic control of pressure rate accord-
ing to lifting stress during digging, which will make it
possible to utilize maximally the capacity of the lifting
engine, to increase the productivity of the excavator, and to
facilitate the work of its operator.

As is known, the Soviet Union is endowed with huge

Table

Одноковшовые экскаваторы Ново-Краматорского машиностроительного завода

Данные	ЭШ-4/40	ЭШ-4/40М	ЭШ-6/60	ЭШ-8/60	ЭВГ-15	ЭВГ-3565
Емкость ковша, $м^3$	5	5	6	8	15	35
Длина стрелы, м	40	44	60	60	36	65
Радиус копания, м	45	45	58	58	40	65
Максимальная высота копания, м	—	—	—	—	30	40
Максимальный радиус разгрузки, м	39	43,5	57	57	37,8	62
Максимальная высота разгрузки, м	19,4	21	24	24	26	45
Вес экскаватора, т	186	176	530	535	1150	2650
Среднее удельное давление на грунт при передвижении, $кг/см^2$	1	0,96	1	1	2,58	2,76
Средняя производительность, $м^3/час$	180—210	190—230	280—300	380—420	755—900	1700

1. Single-Bucket Excavators at the Novo-Kramatorsk Machine Building Plant;
2. Data;
3. ESh-4/40;
4. ESh-4/40M;
5. ESh-6/60;
6. ESh-8/60;
7. EVG-15;
8. EVG-3565;
9. Bucket Capacity, m3;
10. Boom length, meters;
11. Digging radius, meters;
12. Maximum digging height, meters;
13. Maximum discharging radius, meters;
14. Maximum discharging height, meters;
15. Weight of excavator, tons;
16. Mean unit pressure on soil during travel, kg/cm2;
17. Mean productivity, m3/hour.

deposits of mineral resources, which can be worked by means of
bucket wheel excavators. Domestic and foreign experience
shows that the productivity of large-capacity continuous-
action excavators greatly surpasses the productivity of the
largest single-bucket excavators, and the weight of the bucket
wheel excavator and its consumption of electrical energy in
terms of one m3 of hourly productivity are considerably lower.
The use of bucket wheel excavators creates the conditions for
the continuous-flow conduct of mining operations, which en-
sures the maximal productivity and the possibility of a com-
plete automation of all mining operations.

The Novo-Kramatorsk Machine Building Plant completed in
1959 the designing -- and commenced in 1960 the contruction --
of a complex set of mining-transporting continuous-action
equipment with productivity of 3,000 m3/hour, including a
bucket-wheel excavator, a system of trunk belt conveyors, and
two swing-chute spreaders. The first such set will be instal-
led in 1960-1961 in the Nikopol' Manganese Basin.

Brief Technical Characteristics of the Machines in the Set

ERG-1600 Bucket Wheel Excavator

Mean theoretical productivity in compact rock	3,000 m3/hour
Bucket capacity	1,600 liters
Rotor wheel diameter	11.5 meters
Number of buckets	10
Height of worked terrace	40 meters
Scooping depth (bottom scooping)	10 "
Luffing of rotor-wheel boom	31 "
Weight of excavator	3,300 tons

OSh-4500/90 Swing-Chute Spreader

Theoretical maximal productivity (taking account of the crumbling of rock)	4,500 m3/hour
Maximal discharge radius	90 meters
Minimal discharge radius	68 meters
Maximal discharge height	30 meters
Length of receiving bracket	30 meters
Angle of rotation of receiving bracket	+65 degrees
Mean unit pressure on soil when in operation	0.8 kg/cm^2
Weight of machine	765 tons

Trunk Conveyers

Theoretical productivity, taking account of crumbling	4,500 m^3/hour
Width of belt	1,800 mm
Belt traveling speed	3.5 meters/second
Length of conveyer unit	500 meters
Mean running weight of conveyer	0.9 tons/meter

The principal machine of this set -- the bucket wheel excavator -- is equipped with an automatic cutting-control system assuring maximal productivity by varying the RPM of the bucket wheel while utilizing fully the capacity of the bucket whell engine.

The system of trunk conveyers includes: stope conveyer, cross conveyer, and discharge-bracket conveyer. The discharge and stope conveyers are moved by a "turnodozer," while the cross-conveyer is self-propelled, moving on rail tracks. Each conveyer trunk can consist of several units 500 meters long each.

The OSh-4500/90 walking swing-chute spreader was designed on the basis of the ESh-6/60 excavator. The continuity of operation of the swing chute throughout a work shift is ensured by a telescopic device on the dump bracket whose presence makes it possible to enlarge the dump area and to build level-surfaced dumps.

e. ZER-500 Bucket Wheel Excavator

/Following is the translation of an article by G.
A. Rozal'yev entitled "Rotornyy Ekskavator ZER-
500" (English version above) in Gornyy Zhurnal
(Mining Journal), Moscow, June 1960, page 54./

The Zuyevka Foundry and Machine Plant of the Ministry
of Power Stations Construction has completed the designing
and started the production of ZER-500 bucket wheel excavators
with productivity of 500 m3/hour, designed for overburden-
stripping and extraction operations.

Technical Characteristics of the ZER-500 Excavator

Productivity in compact rock (theo-retical)	500 m3/hour
Bucket capacity	200 liters
Cutting stress exerted by bucket	70 kg/cm
Number of buckets	8
RPM of bucket wheel	8.12
Length of bucket-wheel boom from the axis of rotation of the turntable	15.275 meters
Length of boom of dump conveyer	15.5 meters
Height of top digging	12.5 meters
Height of bottom digging	0.5 meter
Discharging height	3.38; 7.47 meters
Cutting radius	17.525 meters
Width of conveyer belt	1,200 mm
Traveling speed of belt of:	
Receiving conveyer	2.5 meters/second
Dump conveyer	2.7 " "
Traveling speed of machine itself	314; 630 meters/hour
Installed capacity	320 kva
Mean unit pressure on soil	1.07 kg/cm^2
Weight of excavator with counterweight	184.3 tons

The first four machines have been sent to the quarries.

f.   ERG-350/1000 Bucket Wheel Excavator

/Following is the translation of an article by B. D. Kharik entitled "Rotornyy Ekskavator ERG-350/1000" (English version above) in Gornyy Zhurnal (Mining Journal) Moscow, June 1960, page 55./

The Machine Building Plant imeni 15th Anniversary of the LKSMU /Lenin's Young Communist League of the Ukraine/ (in Stalino) has built, according to a design by the Novo-Kramatorsk Machine Building Plant, the ERG-350/1000 bucket wheel excavator designed for conducting overburden-stripping work with discharge onto a conveyer or spreader.

Technical Characteristics of the ERG-350/1000 Excavator

Productivity in compact rock	1,000 m^3/hour
Bucket capacity	350 liters
Cutting stress exerted by bucket	80 kg/cm
Number of buckets	8
Diameter of wheel	6.125 meters
Number of scoopings per minute	64
Swiveling speed of excavator	3-33 meters/minute
Height of top digging	17 meters
Depth of bottom digging	2 meters
Length of discharge conveyer	24 meters
Maximal digging radius	24 meters
Traveling speed of the belt of:	
Bucket-wheel conveyer	3.8 meters/second
Discharge conveyer	4 meters/second
Belt width	1,200 mm
Unit pressure on soil	1.0 kg/cm^2
Traveling speed of excavator	240 and 480 meters/hour
Installed capacity	580 kwt
Weight of excavator (with counter-weight)	410 tons

Two bracket cranes, an auxiliary winch and a number of other attachments make it possible to conduct the assembling and repair of all mechanisms of the excavator and the installation of belts without using additional hoisting means, which is particularly important during the winter-spring period when delivery of the machine to open-strip pits is difficult.

Automatic guidance of the drive during digging makes it possible to maintain a stable productivity, as the swiveling rate is inversely proportional to the change in the thickness of cutting.

A provision has also been made for remote control of the swiveling and lifting of the discharge boom from the machine onto which the excavator discharges the rock.

The first specimen of the excavator, on passing plant tests, has been sent to the Chasov-Yarskoye Ore Administration of the Stalinskiy Sovnarkhoz.

g. EPG-1 Underground Excavator

/Following is the translation of an article by Z.
B. Volodarskiy entitled "Podzemnyy Ekskavator EPG-
1" (English version above) in Gornyy Zhurnal
(Mining Journal), Moscow, June 1960, page 56.7

The Dnepropetrovsk Project-Design Technological Insti-
tute has drafted the design of the EPG-1 hydraulic underground
excavator designed for loading cut ore into cars or self-pro-
pelled dollies with capacity of 4 to 8 m^3.

The excavator consists of the following principal units:
running gear 1, turntable 2, mobile carriage 3, steering cab
4, stick 5, turntable mechanism scoop 6, and hydraulic drive
inside casing 7.

The running gear is constituted by a twin-tracked under-
carriage with individual drive of each caterpillar track from
the electric motor. The turntable is executed in the form of
a massive steel frame to which is fastened the central pivot.
Guide rails for the movement of the carriage extend along
both sides of the turntable. A counterweight of iron slabs
is mounted in the rear part of the turntable. The pressure
mechanism is executed in the form of a carriage moving along
the guide rails of the turntable on four rollers mounted on
antifriction bearings; the carriage is actuated by two hydrau-
lic cylinders.

The stick and the hydraulic cylinders for lifting the
stick are joined by a hinge to the carriage. The scoop is
hinged to the stick. The swiveling and lifting of the scoop
are conducted by two hydraulic cylinders. The turntable
mechanism is also hydraulic. The turntable can rotate 300
degrees (+150 degrees).

The hydraulic drive ensuring all working movements of
the excavator (except for travel) consists of a 40-kwt motor,
reducing gear, four pumps with a 100-atmosphere working pres-
sure, and an oil tank with a hydroaccumulator. The pump sta-
tion and the oil tank are covered by a steel casing.

The operator's cap with the control panel are located
in the front part of the carriage.

Technical Characteristics of the EPG-1 Excavator

Productivity	135 m^3/hour
Scoop capacity	1 m^3
Duration of working cycle upon 180- degree pivoting	26 seconds

Maximum discharging height ... 1840 mm
Angle of rotation of turntable ... 300 degrees
RPM of turntable ... 5
Traveling speed ... 0.256 meter/second
Scooping stress exerted by lip of scoop ... 8,700 kg
Number of electric motors ... 3
Total installed capacity ... 68 kwt
Dimensions when in "in-transport" position:
   Height ... 2,350 mm
   Width ... 2,084 mm
   Length ... 4,695 mm
Weight, including counterweight ... 25.3 tons

The smallest possible dimensions of the mine chamber /accommodating the excavator/ are, when ore is loaded into conventional mine cars, on the plane of 6x7 meters (including the drift) at a height of 4.5 meters, whereas when ore is loaded into cars with capacity of 4 to 8 m^3 these dimensions can be correspondingly 8x10 and 6 meters, respectively.

The EPG-1 underground excavator should be manufactured in 1960 at one of the plants of the Sverdlovskiy Sovnarkhoz. The existing model of this excavator will be exhibited in the Pavilion of the Ukrainian SSR at the Exposition of the Achievements of the National Economy in Moscow.

END